

SECTION III.—FORECASTS.

STORMS AND WARNINGS FOR APRIL.

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At the beginning of the month the low pressure over the upper Lake region and the Ohio Valley was causing general rains over much of the eastern half of the country. Temperatures were moderate over the southern districts, and high over the northern, while over the western half of the country pressure was comparatively high with fair weather and nearly normal temperatures. The Lake storm continued eastward with rapidly increasing intensity and on the morning of the 2d was central over the Maine coast, the barometer at Eastport, Me., reading 29.16 inches. Small-craft warnings were ordered for the New England and Middle Atlantic coasts, and winds occurred as forecast. Rains had continued in the Ohio Valley and the Lake region, changing to snow over Lake Superior, eastern Lake Erie, and Lake Ontario, and had extended through New England with strong west to north winds and with snow over the northern portion. It was much warmer in the Atlantic States, and colder in the Lake region and the Ohio Valley. To the westward the weather was fair with high pressure and moderate temperature, except on the north Pacific coast, where the barometer was again falling with local rains that extended eastward into western Montana. At 6:40 p. m. storm warnings were ordered along the Washington and Oregon coasts.

Frost warnings on the 1st and 2d for Missouri, Kansas, Arkansas, Oklahoma, and Texas failed of verification owing to the fact that the recovery from the eastern disturbance was very slow from the upper Mississippi Valley eastward, and cool and unsettled weather with rains and snows continued until the morning of the 4th, by which time the western high area had overspread the East, and killing frosts and freezing temperatures occurred as far south as Tennessee, warnings for which had been issued on the morning of the 3d. A depression that was over the southern coast of California on the morning of the 1st, had by this time reached the mouth of the Rio Grande, and rains were falling over Oklahoma, Texas, and New Mexico. The disturbance on the north Pacific coast had also continued to increase with resulting rains in the Coast States, except southern California. Over the interior West the weather remained fair, with temperatures somewhat below the seasonal average, as a rule. A very moderate depression had also appeared to the northeastward of Lake Superior; it moved eastward without developing any intensity of consequence, but it caused a resumption of rains and snows from the Lake region eastward to New England, and it was followed by another fall in temperatures that brought them well below the freezing point from the upper Mississippi Valley eastward by the morning of the 5th. By this time also the north Pacific disturbance had moved into the Middle Plateau and the rain area had extended into Idaho, Nevada, and south California. Pressure was rising rapidly behind this low with a decided fall in temperature.

By the morning of the 6th the Plateau disturbance had moved to the Texas Panhandle with increased intensity, and an arm of disturbance extended northeastward to southern Lake Michigan. This, with a cool high area to the northward, resulted in quite general rains and snows in the Rocky Mountain region, the Plains States, the Missouri and upper Mississippi Valleys, and the upper Lake region. In the East and South pressure was high with generally clear weather and low temperature, and with frosts once more as far south as Tennessee and North Carolina. West of the Rocky Mountains the weather had generally cleared, and frosts occurred in the north Pacific States, with a recurrence on the following morning, both as anticipated. On the morning of the 7th the depression extended in parabolic shape from Texas northeastward to Ohio, but with diminishing intensity, and the barometer was rising rapidly to the northward and northwestward, with temperatures ranging from 10 to 30°. Small-craft warnings were ordered for the Texas coast. Rains and snows had continued from the Rocky Mountain region eastward to the Mississippi River and the upper Lake region, and had extended through the Ohio Valley and the lower Lake region into the Middle Atlantic States and New England. Pressure was high over the middle Atlantic Ocean, and temperatures had risen decidedly in the Ohio Valley, Middle Atlantic States, and the South. West of the Rocky Mountains the weather was generally clear with moderate temperatures. The western depression drifted slowly eastward with several independent centers of circulation, and on the morning of the 8th it extended from western Florida northeastward through New York, with general rains and snows east of the Mississippi River, with continued high temperatures in the Atlantic States, and abnormally low ones in the Plains States, the Southwest, the Central Valleys, and the Lake region—the line of freezing temperature extending into northern Texas. As this disturbance gave some promise of further development, small-craft warnings were ordered in the evening of the 7th for the New England and Middle Atlantic coast, the warnings to be displayed on the following morning, at which time similar warnings were ordered for the Louisiana coast. With the exception of some snows in the Rocky Mountain region, the weather was generally clear in the West, but with falling pressure in the extreme West and a tendency toward rising temperatures.

As the barometric gradient was quite steep, northwest storm warnings were ordered at 2:30 p. m. on the Gulf coast from Pensacola to Cedar Keys, Fla., and on the Atlantic coast from Jacksonville, Fla., to Boston, Mass., and moderate to strong winds prevailed during the succeeding 24 hours. During the 8th the disturbance contracted somewhat and by the morning of the 9th there was but a single center over the lower St. Lawrence Valley. Rains and snows had continued in the Lake region, New England, and the Middle Atlantic States, and rains in the South with a decided fall in temperature to much below the normal conditions. Cold weather also continued in the Central Valleys and the Gulf States with freezing temperatures into central Texas, warnings for which had been issued on the previous day. Warnings of frost for

the Carolinas and Georgia failed of verification on account of the persistence of cloudy weather. The high pressure area covered the central and southwestern portions of the country, and its eastward drift necessitated additional frost warnings for the Ohio Valley, the Middle Atlantic States, and the South generally, except eastern and southern Florida. Frosts occurred as forecast on the morning of the 10th, when the high pressure and low temperatures covered the East and South, while another disturbance from the Canadian Northwest had reached Minnesota with greatly increased intensity, attended by light local snows from Minnesota westward. There was also another disturbance over the Middle Plateau, and the Pacific coast rains extended eastward to the mountains.

Advisory warnings were issued at 9 a. m. for moderate south to southwest gales on Lake Michigan, and during the afternoon southwest storm warnings were ordered for the southern California coast. By the evening of the 10th the plateau disturbance had moved to southeastern New Mexico with increased intensity and orders were issued to display small-craft warnings on the Texas coast on the following morning, by which time the disturbance was over Texas, while the northern disturbance had passed to the northeastward of Lake Superior attended by light rains and snows, moderate westerly gales, and higher temperatures. This condition of rising temperature covered practically the entire country except the Atlantic and the Pacific States, temperatures over these two latter districts continuing quite cool with light frost as far south as North Carolina. The weather had also been fair except over the region affected by the northern disturbance, but there was another disturbance of moderate character that had moved in from the Pacific coast since the night of the 9th and was central over Saskatchewan by the morning of the 12th. The northern disturbance had reached central Ontario, while the southern one was over the western Gulf of Mexico with resulting general showers from the Gulf States northeastward through Canada. Low temperatures continued quite generally, except in the Southeast, with a further fall over the region covered by the showers. Pressure was high over the central portion of the country with heavy to killing frosts, for which warnings had been issued on the previous morning. Pressure was also higher over the extreme West, with generally clear weather. No storm warnings had been necessary for the northern storm, but small-craft warnings were displayed during the 11th on the New England coast, and northwest storm warnings during the night of the 11th on the north New Jersey coast. Small-craft warnings had also been displayed on the middle Gulf coast for the fresh breezes caused by the Gulf disturbance.

Owing to the continued low temperatures and high pressure in the central West, frost warnings were repeated for those sections on the morning of the 12th and extended into the interior West Gulf States, the Ohio Valley, the north portions of the East Gulf States, and the Middle Atlantic States. Occurrences on the following morning justified these forecasts, except in so far as they related to the Gulf States where more or less cloudiness prevented the formation of frost. By this time (Apr. 13) the northern disturbance had passed off the Newfoundland coast with greatly increased intensity, and high pressure with low temperatures covered the entire eastern half of the country, except the South Atlantic and East Gulf States, where temperatures had not changed materially. A temperature reading of six degrees below zero was reported from White River, Canada, while freezing temperatures generally prevailed over the northern tier of

States from Minnesota eastward. Over the West, pressure was falling with a disturbance approaching the north Pacific coast, and rains were falling in Idaho, Washington, Oregon, and northern California.

The disturbance that was over the western Gulf of Mexico on the 12th apparently reappeared during the 13th and, by the morning of the 14th, it had moved northeastward to Tennessee with increased intensity causing general and, in many places, heavy rains throughout Tennessee, the East Gulf and South Atlantic States, except Florida. Pressure had also fallen generally over the northern and western portions of the country, except the northern plateau, but without precipitation except some local rains in the Northwest and the North Pacific States. Temperatures were generally rising except in few localities. The southern storm did not present a very well-defined formation, but moved northeastward with two centers that, on the morning of the 15th, were over Kentucky and eastern North Carolina, respectively. Rains continued in the South and extended through the Ohio Valley and the southern portion of the Middle Atlantic States. Strong high pressure continued to the northeastward but no high winds had as yet occurred. In the West conditions had not changed materially, except that another disturbance from the Pacific had reached Alberta attended by general rains in the North Pacific States, including northern California, and temperatures had risen generally, except in the Northwest, although still below the seasonal average over the eastern half of the country. During the 14th northeast storm warnings had been ordered on the Atlantic coast from North Carolina to Cape Cod, Mass., and, on the morning of the 15th, for the balance of the New England coast. Moderately high winds occurred and the slow northeastward movement of the storm necessitated a continuance of the warnings on the night of the 15th from Delaware Breakwater to Cape Cod. They were, however, lowered on the morning of the 16th from Delaware Breakwater to New Haven, Conn., by which time the storm center was off the southern New England coast, still moving northeastward.

By the night of the 16th the northwestern disturbance had practically disappeared while the Middle West one had moved to western Kansas with increasing energy. As this latter disturbance appeared to be developing rapidly, southeast storm warnings were ordered at 10 p. m. for Lake Michigan, and small-craft warnings for the following morning on the Gulf coast. However, the western disturbance did not move eastward as fast as had been expected and by the morning of the 17th it was central over eastern Nebraska, and consequently no strong winds occurred on Lake Michigan. Although temperatures rose decidedly to the eastward and southward of the disturbance, there was no precipitation, except some local rains and snows in Colorado, Wyoming, and the Northwest. The eastern disturbance had moved to the Nova Scotia coast and the rains and snows in the lower Lake region, the Middle Atlantic States, and New England had practically ended. The extreme western high-pressure area had moved into the northern plateau attended by interior frosts over the north Pacific States and the plateau regions, for which warnings had been ordered on the 16th. The western storm developed more to the northeastward during the 17th and at 3:30 p. m. of that date northeast storm warnings were ordered on Lake Superior from Duluth to Marquette; and, as the western depression also dipped southward into Texas, small-craft warnings were ordered on the west Gulf coast at Galveston. Frost warnings were again repeated for the north

Pacific States, Utah, Colorado, and northern New Mexico and frosts occurred on the morning of the 18th as forecast. The western disturbance still continued its very slow east-northeast movement and it now extended from Minnesota southward to western Missouri with a moderate secondary disturbance near the mouth of the Rio Grande. Rains had begun to the eastward and southward extending from Texas to Lake Superior. There were also quite general rains in the Northwestern States and local snows and rains in the central Rocky Mountain region. As the western storm appeared to be developing, southwest storm warnings were ordered at 10 a. m. for Lakes Huron, Erie, and Michigan with instructions to change to northwest at sunset on Lake Michigan. At 3:30 p. m. northeast warnings on Lake Erie were changed to northwest and northwest warnings were also ordered for the remainder of Lake Superior. To the eastward and southward fair weather continued with high pressure and higher temperatures, while west of the Mississippi River—at least as far as the Rocky Mountains—temperatures were somewhat lower. The extreme western high area had moved into the interior over Idaho and western Montana, and the barometer was again falling rapidly over the extreme north Pacific coast with rains in that section.

During the afternoon of the 18th southwest storm warnings were extended to Lake Ontario and on the same evening southwest warnings were also ordered for the extreme north Pacific coast. On the morning of the 19th the storm center was over northern Lake Michigan with increased intensity (29.42 inches at Green Bay, Wis.). Rains and snows had fallen generally between the Mississippi River and the Allegheny Mountains and strong winds or moderate gales had occurred over the upper Lakes and on Lake Erie. The disturbance that was over the mouth of the Rio Grande had also moved northeastward to southwestern Alabama, causing general showers in the Gulf States, except interior Texas. Temperatures had risen decidedly in the New England and the Middle Atlantic States and the lower Lake region, where they were from 15 to 30 degrees above the seasonal average, while over the upper Lake region and the Central Valleys they had fallen decidedly and were again below the seasonal average between the Mississippi River and the Rocky Mountains. Storm warnings on Lake Huron were changed to northwest at 10:30 a. m. on the 19th and also continued on Lake Erie with instructions to change to northwest at sunset. Small-craft warnings were also ordered on the east Gulf coast for strong winds that would be caused by the disturbance over southeastern Alabama. As the northern storm had now developed a more active eastward movement, frost warnings were ordered for the Ohio Valley, Tennessee, northern Alabama, warnings of frost and freezing temperatures for Indiana, advisory warnings for snow and much colder weather for Michigan, and warnings of frost or freezing temperatures for Illinois and the entire central west. Frost and freezing temperatures occurred generally on the morning of the 20th as previously forecast, except in Kentucky, Tennessee, and northern Alabama, where unsettled cloudy weather persisted.

The disturbance that was noted over the extreme north Pacific coast on the morning of the 18th had by this time reached Saskatchewan with much increased development and with light rains in the Northwest, while the Middle West low area had reached the New England and the Middle Atlantic States with very indefinite development, but with general rains and snows east of the Mississippi River and with continued high temperatures in the Middle Atlantic and New England States. Small-craft

warnings were ordered at 10 a. m. from Norfolk, Va., to Eastport, Me., and, as the disturbance gave promise of renewed development, northeast storm warnings were ordered at 9:30 p. m. for the eastern Maine coast, at which time the storm center was off the Massachusetts coast moving northeast. By the morning of the 21st the northeastern storm was off the Nova Scotia coast, but rains had continued in New England, the Middle Atlantic States, and the lower Lake region. Pressure was high over the Ohio Valley and the South, and frosts had occurred in Kentucky and Tennessee. It was considerably colder in the Atlantic States and the lower Lake region, warmer from the upper Lake region southwestward, and generally colder in the Northwest and the extreme West. The northern disturbance of the 20th had moved to Lake Superior with greatly decreased energy, while another of more marked character had developed over southern Nevada, the general depression extending eastward over Kansas and Nebraska, with a moderate high area to the northward that was causing local snows and rains in Montana, Wyoming, and Nevada. There had also been quite general frosts in the north Pacific States for which warnings had been issued on the 20th; these warnings were repeated on the 21st for the frosts that again occurred on the following day. Frost warnings were also issued on the morning of the 21st for Delaware, Maryland, east Pennsylvania, and Virginia; but they did not materialize generally on account of the southeastward movement of the Ohio Valley high-pressure area. On the morning of the 22d the northwestern high area was found to have developed considerably and, with its crest over northern Minnesota, was moving eastward after the Lake Superior low area that had moved to the lower St. Lawrence Valley with increased development, attended by local thundershowers in the Lake region. Pressure also continued high in the South with fair weather, except in east Texas, where general rains were falling with the southeast wind blowing from the Gulf of Mexico into the western disturbance, which by this time had reached northern Arizona. The general depression had also extended eastward in very moderate form, so that it reached between the two high areas with resulting unsettled weather but without precipitation of consequence.

On the morning of the 23d the western depression was central over eastern Colorado, with a secondary center over southern Alberta. The southern high area had lessened somewhat, while the northern one had increased materially and was central over northeastern Michigan with a crest of 30.62 inches. It caused a general and decided fall in temperature from the upper Ohio Valley and the upper Lake region eastward, while to the southward temperatures remained comparatively high. It was also much warmer in the Northwest and colder in the Middle Plateau and the extreme Southwest. The only precipitation of consequence covered a narrow belt extending from east Texas northward to the Canadian line. On the morning of the 24th the principal storm center had moved to northwestern Iowa, while the northern secondary one had moved to western North Dakota; this had resulted in the extension of the rain area eastward through the upper Lake region, and weather had become cloudy and unsettled throughout the Ohio Valley and the South. It was considerably warmer in the upper Mississippi Valley, but elsewhere temperature changes had not been of consequence, and in the far West pressure had risen considerably, but with light local rains in Montana, Idaho, and Utah. Frost warnings were ordered for the north Pacific States. The western

disturbance continued northeastward with about the same intensity, and on the morning of the 25th it was central over northern Lake Michigan, but, as pressure was still low for a considerable distance to the westward, there had been no strong winds. The rain area had extended through the Ohio Valley and the Lake region generally and locally into the Middle Atlantic States. There had also been substantial thundershowers in the west Gulf States. Temperatures were much higher over the eastern half of the country but were moderate elsewhere, with frosts in the interior of the north Pacific States. Owing to the strong pressure gradient to the eastward of the storm center, southwest storm warnings were ordered at 10 a. m. for Lake Ontario and extended on Lake Erie. However, they were not verified by subsequent occurrences, as the disturbance rapidly disintegrated during the night of the 25th, and on the morning of the 26th rains were falling in western New York, the Middle Atlantic States, and New England, with some snow over northern New England. By this time another disturbance had developed over the extreme West and was central over northwestern New Mexico, with rains continuing over Texas.

The northern disturbance moved off the southern New England coast and was followed by clearing weather, but the southwestern one moved eastward, and on the morning of the 27th it was central over western Oklahoma, with a secondary center over the middle Rio Grande Valley of Texas. Pressure was rising rapidly to the northward, with a marked crest over northern Saskatchewan, and at the same time temperatures had fallen considerably below the freezing point in North Dakota. Rains continued in Texas and extended northeastward into the upper Mississippi Valley. There were also rains in the North Pacific States, snows and rains in the central Rocky Mountain region, and rains in New York and New England, the latter from the northern low area that was just passing off the south coast. High temperatures prevailed in the upper Lake region and the Central valleys. Small craft warnings were ordered on the Texas coast, and on the east Gulf Coast from Pensacola to Carrabelle, and, as pressure was again rising in the North Pacific States, frost warnings were ordered for that section. Heavy to killing frosts occurred on the morning of the 28th as forecast. Warnings were also issued for the frosts in northern New Mexico that occurred on the morning of the 28th.

As special observations received during the 27th indicated the northeastward movement of the Oklahoma disturbance, small-craft warnings were ordered at 3 p. m. for western Lake Superior and, as the night observations indicated a still further development of the cold, high area to the northward, northeast storm warnings were ordered on Lake Superior from Duluth to Ashland. On the morning of the 28th the Oklahoma disturbance was over the upper Mississippi Valley, while the secondary one was near the mouth of the Rio Grande. Strong, cold, high pressure lay like a saddle over the northern disturbance, with distinct crests of about 30.40 inches over northern Saskatchewan and the territory immediately to the southward of Hudson Bay, and there had been also a decided fall in temperature to much below normal conditions through the Plains States and the Southwest, with low temperatures continuing in the Northwest and the Far West.

As conditions were now more marked, northeast storm warnings were ordered during the 28th for northern Lake Michigan, and during the evening of the 28th for the remainder of Lake Superior, while at the same time they

were continued over western Lake Superior, warnings also containing information that snow was probable over Lake Superior. Warnings of heavy frosts or freezing temperatures were also issued for the Northwestern States as far south as Nebraska and northwestern Iowa, and they were also repeated for the North Pacific States. Snows and winds occurred as forecast on Lake Superior and northern Lake Michigan, and on the morning of the 29th the storm was central over eastern Lake Erie, with much diminished intensity, having turned to the eastward after reaching southern Lake Michigan. Snows and rains were falling generally from the Ohio Valley and the Lake region eastward, and thunderstorms also extended into the eastern Gulf States. Over the West and the extreme North pressure was high, with abnormally low temperatures that had extended by this time into the upper Lake region. Frost again occurred in the North Pacific States and light frosts as far south as southwestern Kansas. In the Atlantic States temperatures were high.

On the morning of the 30th high pressure prevailed throughout the country except along the Atlantic coast and in the extreme Southwest, but with generally cloudy weather and with local rains and snows east of the Rocky Mountains. The center of the high pressure was over Lake Superior (Port Arthur, Canada, 30.62 inches) and, as special observations indicated a rapid clearing of weather, frost warnings were issued for the lower Lake and southern upper Lake region, the upper Ohio Valley, and the Middle Atlantic States. On the morning of May 1 frosts occurred as far south as Virginia and Kentucky, the clearing weather having moved a little farther southward than had been anticipated. At the end of the month fair weather and high pressure prevailed generally, except in the extreme Southwest and the extreme Canadian Northwest, with low temperatures generally except in the Pacific States.

NORTHERN HEMISPHERE PRESSURE DISTRIBUTION.

The high pressure that had prevailed during most of the month of March over Alaska and the Aleutian Islands continued during the first two decades of April with some diminution in magnitude over the Aleutians and a moderate increase over western Alaska. After the 10th of April moderately low pressure prevailed over the southern and after April 20 over the northern and eastern sections, but with some recovery during the latter days of the month.

Over the Pacific States there was a rapid alternation of high and low pressures, but none were of decided character except the low area that prevailed on the California coast on the 21st and 22d. In the interior, as far east as the Missouri River and southward to Texas, high pressure predominated largely during the first decade of the month with a principal crest on the 7th over the Canadian Northwest. These conditions of high pressure were followed by a return to more normal conditions with the usual alternation of moderate high and low pressures, with the latter predominating somewhat, until the last few days of the month, when there was a return to somewhat above normal conditions. East of the Missouri River there were no special features connected with the pressure. There were only two quite well-marked disturbances over the upper Lakes and also one or two fairly strong high pressure areas, but nothing of particular consequence. Over the East and Southeast the storm movement was somewhat more active, but without any strong high-pressure areas following. There was strong storm development over the northeastern sections on the 2d and

3d, on the 13th, and again during the last two days of the month. The Middle and South Atlantic States did not exhibit any special changes, and, on the whole, above-normal pressures predominated slightly. Over the western Atlantic Ocean, as indicated by reports from Bermuda and Turks Island, moderately high pressure prevailed throughout the month, with a few minor exceptions. Over the eastern Atlantic, as indicated by reports from the Azores, similar conditions prevailed except during two days, and on the last day a pronounced disturbance prevailed. Over the British Islands and Iceland, after three or four days of normal conditions, abnormally low pressure prevailed, particularly over Iceland, until the 14th when there was a return to high pressure for the remainder of the month, except over Iceland where it remained low almost constantly until the last two days of the month. Over western continental Europe high pressure also prevailed generally, except for a few days during the first half of the month, and between the 15th and 28th high pressure was quite marked over Germany and France. Farther northward to the Arctic Circle pressure conditions did not differ much from the normal during the

first decade of the month, but after that time pressure was abnormally low with an occasional reaction toward normal conditions. Over eastern Europe there were alternations of moderate high and low areas during the first two decades of the month, but during the third decade pressure was generally low with a marked minimum on the last day of the month over northern Russia. It should be remarked, however, that over southeastern Europe there was no low pressure of consequence, moderately high pressure prevailing generally. Over Siberia there was a general tendency toward low pressure with a decided fall on the 6th and 7th, and again on the 23d and 24th. There were no marked high areas after the fifth day of the month. The same general conditions that prevailed over Siberia also extended southward over eastern China and Japan.

Over the North Pacific Ocean, as indicated by reports from Honolulu, there was a continuance of the low pressure of the previous month that lasted until the 19th, with quite marked depressions on the 2d and 10th. After the 19th there was a return to slightly above normal conditions until the 28th, when pressure again fell to normal.